

DOCUMENT RESUME

ED 145 351

CG 011 903

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TITLE Behavioral Path Analysis and Environmental Evaluation.
PUB DATE Apr 77
NOTE 17p.; Paper presented at the Annual Meeting of the Western Psychological Association (Seattle, Washington, April, 1977)

EDRS PRICE MF-\$0.83 HC-\$1.67 Plus Postage.
DESCRIPTORS *Architectural Research; Behavioral Science Research; *Building Design; *Environmental Influences; *Environmental Research; *Facilities; Interaction Process Analysis; Research Methodology; *School Design; School Environment
IDENTIFIERS *Behavioral Path Analysis

ABSTRACT

Behavioral Path Analysis is both a theory and a methodology for studying person-environment interactions. It is designed to be applicable to the evaluation of both environments in use and proposed designed environments. This paper presents the basics of the theory, and some examples of recent applications that have guided its development. The theory relies on a control system model, and views performers in environments as being either constrained or facilitated in carrying out their purposeful activities by environmental elements that either prohibit or promote control of relevant sensed conditions. Part of this theory has been operationalized as design exercises conducted with some alternative school teachers and administrators who desired to analyze their school setting. Some preliminary results of these exercises are presented, and the analysis is briefly compared with some concepts other investigators have used in similar work. (Author)

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BEHAVIORAL PATH ANALYSIS AND
ENVIRONMENTAL EVALUATION

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Prepared for the Western Psychological Association Conference
Seattle, Washington April 21-23, 1977

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BEHAVIORAL PATH ANALYSIS AND ENVIRONMENTAL EVALUATION

INTRODUCTION

Behavioral Path Analysis (BPA) is both a theory and a method for studying person-environment interactions. It is designed to be applicable to the evaluation of both environments in use and proposed designed environments. In either case, BPA attempts to identify the systemic "flowpaths" that are formed when people and environments interact. So the "behavioral path" of its title refers to person and environment treated as a system rather than as individual units. The output of BPA is a description in terms of such "flowpaths" and tells succinctly "where the system is going" by expressing the relative strengths of human activities and the availability and variety of environmental elements that support them.

Behavioral Path Analysis is derived mainly from Powers' (1973) control model of behavioral organization and Bateson's (1972) concepts regarding the "economics of flexibility". Within the framework these authors have provided, we have constructed BPA as a pragmatic tool particularly useful:

- a. when one seeks to perform an environmental interaction and wishes to predict main and side effects of this action.
- b. when one is confronted with studying a person-environment interaction of which there is little prior knowledge, so that there is even a question as to "what to look for".
- c. when one wishes to construct a self guided experience for increasing environmental awareness among performers in a given setting.

The necessary definitions, theory, and application of BPA to each of these shall be considered in turn.

DEFINITIONS

Behavioral Path Analysis (Fig. 1.) begins with circumscribing the person-environment system under consideration. The person-environment system is closed by setting either a purposive or a spatial boundary and then allowing the other to vary over a manifold of possibilities.

For example, a spatial boundary may involve a room or set of rooms with circulation spaces: a building or any designated physical extent. A purposive boundary may designate a purpose (or set of purposes) such as "to eat lunch", "to walk the dog", or "to write a research paper". In either case, as soon as either the spatial boundary or the purposive boundary is fixed, the other is left free to vary in the process of the analysis. In this manner, the effect of artificially restricting the scope of the analysis too early, and missing some important implications, is hopefully minimized.

Practically, though, we have found that if the analysis does not begin with fixing spatial or place boundaries, then it begins on a level which we have called roles, which involves a more general description of purposive boundaries. These are loosely distinguished as the roles individuals play in settings. Roles are operationalized through purposes, so the exact labels and distinctions made at this level are relatively unimportant. Unless a designated role can later be shown to possess a distinct path through the remaining levels of analysis, it is combined with another role category with an identical path.

In a recent BPA exercise, a design team generated a set of roles for performers in beginning considerations for the design of a bus shelter in a downtown, metropolitan location. In the delineation of roles many other spaces besides that described by the shelter became explicit in the analysis. These included display windows, building entrances, the sidewalk, utility poles and the curbside and street. This is not to say that a design team would not consider these in using a more unstructured, intuitive approach, but rather that here an immediate "why" was given to the consideration of these adjacencies. It is because these are the spaces in which the various roles are carried out, and they cannot be ignored if those roles are to be included.

Roles and places are treated on the same level of analysis. Both of these resolve into the level of purposes. Roles are seen as complexes of purposes, and places as complexes of opportunities for purposes to become manifest in behavior.

Purposes themselves become operational and are revealed by what are called "sensed conditions" after Powers' (1973). Sensed conditions are the controlled quantities that govern behavior. When an individual acts, he/she does so in order to maintain or re-establish a sensed condition(s) which guide(s) a purpose, and from our analytical perspective, operationalizes the purpose.

For example, perceived body temperature, or eye contact among strangers, the maintenance of interpersonal spacing, or even a "sense of competence" (Perin, 1970) may be sensed conditions. By and large, sensed conditions are unavailable except to the behaving person, and even here an individual may be unaware of them in so many words. Sensed conditions are hypothetical but their inclusion as an operationalization of purposes provides two advantages:

First, they provide the opportunity for explicit and sensitive simulation testing in or out of the environmental context in which they are hypothesized to govern activity.

Second, they provide an explicit link to environmental elements - aspects of the environment that provide the necessary facilitation or constraint for the control of sensed conditions. It is at this linkage between sensed conditions and environmental elements that the critical questions of BPA are raised.

Given that we recognize that people in a setting hold certain purposes (or we wish them to), and that the fulfillment of these purposes may involve a variety of actions, what are critical "sensed conditions" that guide fulfillment of the purposes? The specificity of behavior is directly affected by environmental elements which may constrain or encourage variety of behavior, but the underlying sensed condition(s) for a given purpose remain the same.

Consider a single example of perceived body temperature, a sensed condition, that may guide behavior in two different settings:

At home in a living room; if we feel cold, we may

- a. turn up the thermostat
- b. start a fire in the fireplace
- c. put on a sweater
- d. shut the window
- e. change our seat, or . . .

At a bus stop downtown; if we feel cold, we may

- a. stand in a nearby doorway
- b. stand behind a telephone booth
- c. stand behind other people
- d. go into a store temporarily, or . . .

in an observation description none of these behaviors in either set overlap, yet they are governed by the same sensed condition and the same purpose, i.e. to re-establish perceived body temperature at a higher level.

Whatever activity does occur will depend on what opportunities the environment allows. In the analysis of designed environments, BPA asks what are the environmental elements available for the control of sensed conditions that are necessary to guide the fulfillment of purposes which we wish to see supported by the environment.

Different behavioral ways of fulfilling an invariant purpose across given place(s) per unit time constitute the flowpath of the purpose (Fig. 2). So we may observe that a city park offers different ways for office workers to eat their lunch. There may be park benches, seating on the grass, or even the opportunity to perch on cement ledges around fountains or walkways. Each of these possibilities provides a different way of fulfilling the purpose "to eat lunch in the park"

The number of different ways of fulfilling a particular purpose is the variety of the flowpath of that purpose. Each way is distinguished from another if it relies on different environmental elements or qualities for maintaining the sensed condition necessary to the fulfillment of the purpose. In the example above, the variety of ways is easily recognizable, because each is defined by a different environmental element. However, the same element may function in more than one way, so that variety of a flowpath is increased without increasing the number of elements.

Suppose that in setting up a faculty office, we desire to have easy access to a bookshelf from the desk. We achieve this by leaving an open circulation space between bookshelf and desk that allows us to easily walk over to the bookshelf from where the desk is placed. However, if the floor surface texture also allows one to roll over a desk chair on casters to the bookshelf, then this is another unique 'way' of reaching the bookshelf, since it relies on the type of floor surfacing as well as the circulation space.

The strength of the flowpath is the number of performers using each way per unit time combined across the number of ways open per unit time. Strength of flowpath is therefore a vector quantity, since it contains both magnitude (number of performers) and direction (variety of ways). Two flowpaths are identical only if they are equivalent in all of their components.

A set of purposes and their flowpaths is called the behavioral trajectory of the person-environment system. At present, this completes the description of a person-environment system under BPA.

THEORY

The definitions above contain some subtle theoretical distinctions worth noting. First, time is treated in BPA as a scale-setting factor, since all summations are over a unit interval. This means that the analysis may involve either macro (e.g. tracking over time) or micro (e.g. slice-of-time) methods.

Second, strength of a flowpath is measured through direct observation, but variety is not. Variety depends not only on the number of ways observed,

but also on the number of ways possible. The observed variety may be much less than the potential variety. That is, observation may show that performers in a setting consistently use only a limited number of the ways open to them for fulfilling a certain purpose. Now, generally we expect purposes to be expressed in as many ways as possible since this diminishes competition for the same supporting environmental elements. But if a restricted pattern occurs then it is indicative either of low demand of the purpose, or of the actions of some other behavioral or environmental constraints. A constraint may be treatable through an appropriate environmental intervention if the desire is to increase or decrease the strength of a given flowpath.

Environmental behaviors may also be deliberately suppressed by other than direct reinforcement-contingent means. This involves affecting them by a much more surreptitious route that acts by removing constraints in competing behaviors which thereby increase in strength because they become able to utilize more of the existing variety inherent in the setting. This is not unimportant, because it often provides a means of practicing a philosophy of minimalist intervention in the environment. Basically, this notion is that the solution to specific problems involving person-environment systems should be sought by performing the least impacting action on the system necessary to rectify the situation.

An example of this is given in Wise (1977) in discussing the characteristic use patterns observed on an asphalt path surrounding a lake-park. The Department of Park and Recreation had proposed closing the path to bicycle traffic (and building another path for bicycles!) because of accident risk to pedestrians. Systematic observation of use patterns, however, suggested that an equivalent reduction in accident potential could be achieved simply by reversing the prescribed directionality of the bicycle lane adjacent to the pedestrian lane. This was because there was a strong directional preference for pedestrians to move in the same direction as bicycle traffic, and thus be overtaken from behind. Cyclists were required to move in the same direction by park rules, creating a potentially hazardous overtaking situation. By having cyclists approach pedestrians from the front, it became possible for both types of users to share control for the mutual movements that pre-empt collisions. In this situation, behavioral path analysis was used to construct the type of systematic behavioral observation that led to the alternative formulation of a solution. In instances of this kind, BPA follows the type of explanation termed "cybernetic" by Bateson (1972):

"We consider what alternative possibilities could conceivably have occurred and then ask why many of the alternatives were not followed, so that the particular event was one of those few which could, in fact, occur."

If there is a given variety of flowpaths available to a purpose, then as an a priori condition, BPA imposes a uniform density distribution over the strengths of the individual paths. As observations indicate departures from this imposed symmetry condition, the actions or certain constraints are called into question. Where constraints are environmental, they can be modified. Where they are behavioral (e.g. resulting from social or cultural norms) then they can be often used to advantage to work with a setting rather than in spite of it. Oftentimes, it is not even necessary to precisely identify the origin of a particular constraint in order to use it to work for an environmental interaction. We were never able to explain why a predominance of pedestrian traffic moved around the lake in a counter-clockwise direction (Wise, 1977)

although several hypotheses were suggested. But the finding was consistent across density conditions and time of day, indicating it was a stable enough pattern to be exploited as a way of reducing accident hazard.

The theory of BPA is presently being developed further along the following lines:

Given that flowpaths may be represented as vector quantities, to what degree does this allow the techniques of matrix algebra to be used in simulation modeling of a person-environment system? For example, consider the matrix formed to represent a particular purpose (Fig. 3). Each flowpath is a column vector, while rows represent environmental elements active in the different flowpaths.

		PURPOSE FLOWPATHS						
		f_1	f_2	.	.	.	.	f_n
ENVIRONMENTAL ELEMENTS	e_1							
	e_2							
	.							
	.							
	e_n							

Figure 3. A Matrix for a Particular Purpose

Column entries may represent observational data indicating the strength of a flowpath, or a binary matrix may be used to represent which of possible flowpaths are open through particular elements. The question is whether, given this representation, we can simulate the interaction of different purposes where flowpaths intersect in the same elements. For example, is it possible to use the concept of variety of a flowpath in this more precise way, so that we can more accurately predict the suppression effect on one set of purposeful activities if we introduce more environmental variety in an attempt to increase other purposeful activities?

Questions like these remain to be answered, but in the interim, we have found that even the less precise formulations of BPA have led to some interesting methodological approaches that have proved useful in application. Some of these have been mentioned in reference to structuring a design methods approach and systematic naturalistic observation. The most direct procedural adaptation of BPA, though, has occurred through our attempts to develop a self-guided environmental awareness process for alternative school faculty and staff.

APPLICATION TO DESIGN OF A SELF-GUIDED EVALUATION PROCESS

The process was first tested with the staff of an alternative school located in a partially condemned old public school building. The initial problem encountered in presentation of the process involved the question of how much theoretical and conceptual material to include in introducing the process. In this respect we felt that theory is for academicians and that the process should be primarily oriented toward increasing awareness from whatever conceptual framework a person using it would hold.

Our first attempt with six alternative school teachers proceeded from a direct visual extrapolation of the model. We simply had them construct individual flowpath diagrams for their own roles and purposes in the school setting. The explanation given for this task was that we wished to see how their purposeful activities connected to the use of their spaces throughout the school. One of the authors explained the technique and helped generate examples for the various levels of connections required in the diagram. After the participants gave assurances that they understood what was required, they were left to work through the process and develop their own diagrammatic models over a two-hour period.

Figure 4 is an example of the types of entries that occur in working through the diagram. Figure 5 is a flowpath diagram for an alternative school administrator, with a partial listing of elements. Note that some elements have multiple connections to purposes. These should not be construed as an indication of the importance of the element. The administrator here remarked that she would "find it impossible to hold problem-solving conferences without her kleenex in her office", and that she would rather go without chairs than be without her kleenex. So in this representation, value information is not represented, although we suspect that generally, as the availability of environmental elements to different purposes increases, the value of the element does also.

Another interesting feature is to look for the lack of connections where you might expect them. Notice that there is no connection between the stated purpose of "paperwork" and the element "door". For this administrator, the door was never shut unless there was a problem-solving or disciplinary conference, and she felt this action was a strong reflection of her particular policy as an administrator.

Of course, the flow diagrams turned in by the six alternative school staff members were not as easily readable, by the staff or ourselves. One of the first changes we are introducing into the process is to provide some pre-drawn diagrammatic parts that allows the individual to "fill in" connections in an orderly manner so that his/her diagram is easily readable by others.

When the group did compare their diagrams in a short session, their general commentary mainly concerned how fragmented their use of space was in the school - something they had never realized before. There was also some frustration over the process as being too time-consuming, and they often had difficulty in deriving purposes from their perceived roles. Surprisingly, there was a unanimous preference to generate the diagram by starting with roles and moving to spaces, then purposes. The participants expressed a great deal of confusion and insecurity at the idea of going from roles to purposes directly. This may be an anomalous finding from our particular group, or it may indicate a special way in which the process requires people to organize their environmental experience. Diagramming proceeds more easily when

people consider what purposeful activity they are concerned with in a particular space rather than when carrying out a particular role.

Our own analysis of the participants' diagrams provided two main results in addition to individual patterns we were able to discern:

First, the ten different role labels generated by the six participants could easily be condensed into six distinct roles, given the expressed purposes. This may reflect the lack of making some difficult distinctions on the part of our participants; but knowing the setting, we believe it indicates participants' desire to label themselves distinctly in the social organization although their labels often entail identical, purposeful activities.

Second, the spaces of the school that appeared in the diagrams included some which are used by staff for a large number of purposes, and others that were used by one person for only one purpose. We wonder whether with this kind of information - what spaces receive what kind of use and by how many people - the staff could consider if there were an efficient use of space in terms of their programmatic objectives. We are presently preparing a second session with the staff participants, and this type of information is part of the feedback we will provide into the second cycle of activities.

Generally, our first experience with trying to adapt BPA as a self-guided environmental awareness process has indicated that we will have to provide a more directive structure than what would have been preferred. We also intend to approach the process iteratively, breaking down only one role into purposes, etc. first, and cycling through intermediate comparison stages. On the positive side, the process does seem to provide worthwhile information that is not obvious to the participants, and that does not require elaborate statistical treatment to uncover. By working even simple summary procedures into the method, the participants would be able to generate even more insights than what the process itself evokes.

DISCUSSION AND CONCLUSIONS

From our work so far, we have come to regard Behavioral Path Analysis as an extremely pragmatic approach to the evaluation of person-environment interaction. Although the terms we have used may give the impression that this is mainly a theoretical endeavor, there is actually only one central concept to BPA, and that is the idea of control. The questions BPA asks are all concerned with the loci of control among performers in a setting, and how control may be restricted where it is unwanted and otherwise facilitated for desired purposes. Our use of the concept of control should not conjure up images of either Walden Two or Wolf Hilbertz's (1972) evolutionary environments. Control in the sense we contemplate is through an individual and not over him/her. Also, control does not require highly automated, responsive environments utilizing a high level of technology. For an individual to have control over a sensed condition of environment means simply that the person possesses the response capability to cause that condition to vary in as many of the possible ways that it can. We

believe that this is the basis of the "freedom of choice" that Proshansky, et al. (1970) emphasizes, as well as, the "extent to which the environment responds to the stimulus of human demands" that Perin (1970) has alluded to. The different means of control correspond to the ways in which a purpose can be fulfilled, and we say that an environment has "flexibility" in direct proportion to the variety of the flowpath of the purpose. This conception of flexibility, we maintain, is much more useful (from an evaluation perspective) in considering questions about the "complexity" of environments than is the "ambiguity" of Rapoport and Kantor (1967) or the "complexity" of Venturi (1966).

Methodologically, BPA is reminiscent of the "design option decision trees" of Askren and Korkan (1971) and of heirarchical methods in general. But where heirarchies become more specific, breaking down entries within categories, BPA becomes more specific while "flipping" from environmental to behavioral categories on alternative levels. The richness of interconnections across levels also illustrates BPA's organization conceived as a semi-lattice rather than a hierarchy.

In this first year that we have developed Behavioral Path Analysis, we have found repeatedly that it improves with added precision, both in the amount of information it is capable of conveying to the design researcher and its ability to synthesize disparate, empirical phenomena into a common framework. More initial tests of its predictive value in simulation study await our attempts to transfer its concepts into mathematical descriptions. But even at this stage of consideration it has provided us with a fresh and provocative way of conceiving how people and environments interact.

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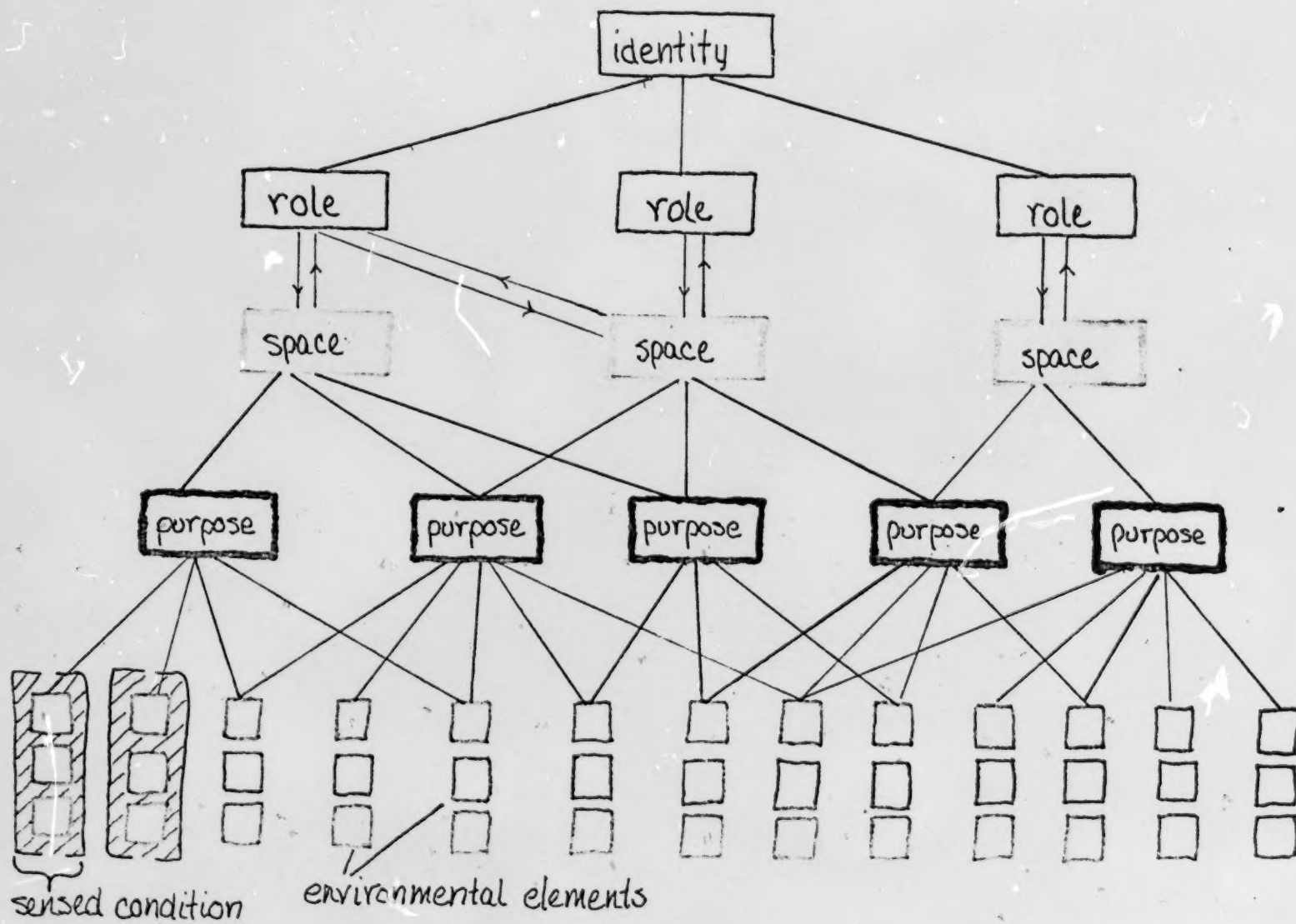
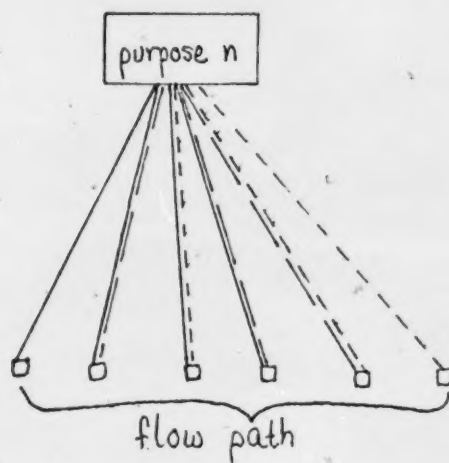
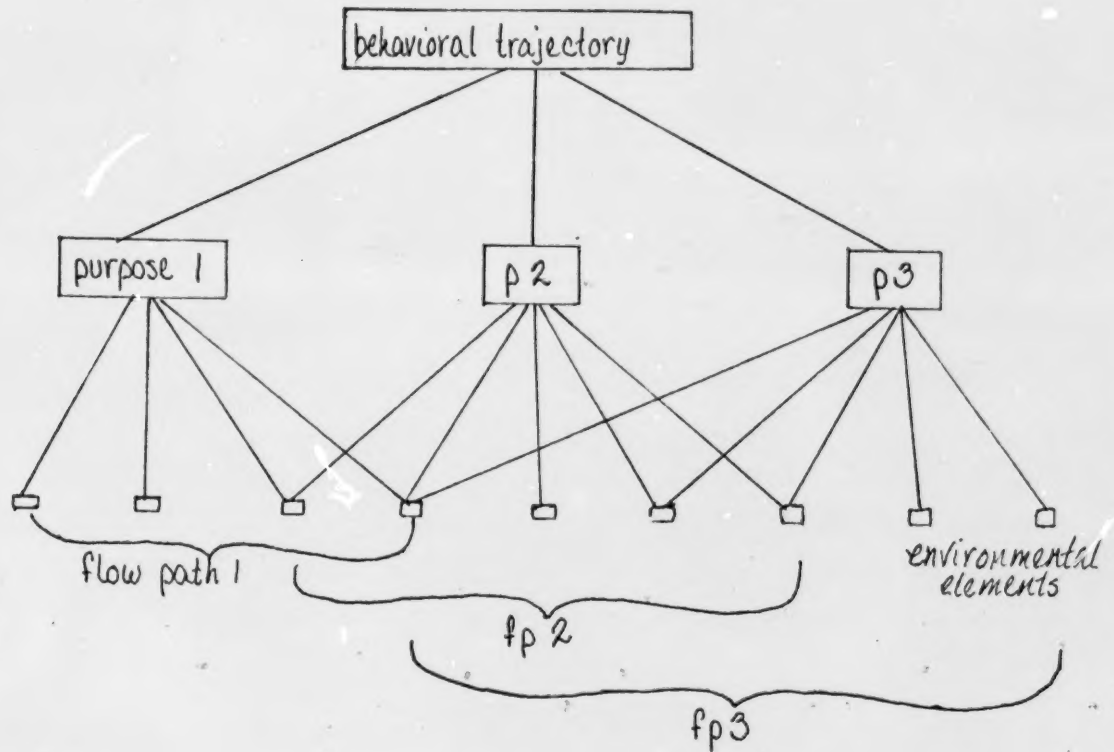


Figure.1. A schematic model of the Person-Environment System in terms of Behavioral Path Analysis



way 1: —

way 2: ---

way 3: ----

Figure 2. A schematic model of the purpose flowpaths in a Person-Environment System.

NAME: EBK

ROLES: Administrator
Counselor
Teacher

SPACES: Office (Administrator and Counselor)
Hall (Administrator and Counselor)
Classroom (Teacher)

Purposes

SPACE: OFFICE

1. To do necessary paperwork
2. To conduct disciplinary conferences
3. To conduct problem-solving conferences
4. Informal contact with staff and students

Environmental Elements

PURPOSE: PAPERWORK

1. Non-public display of notes to self
2. File containers
3. Bookcase for display and access
4. Phone
5. Flat writing surface
6. Typing space

Figure 4. Entries from a BPA diagram for an alternative school administrator.

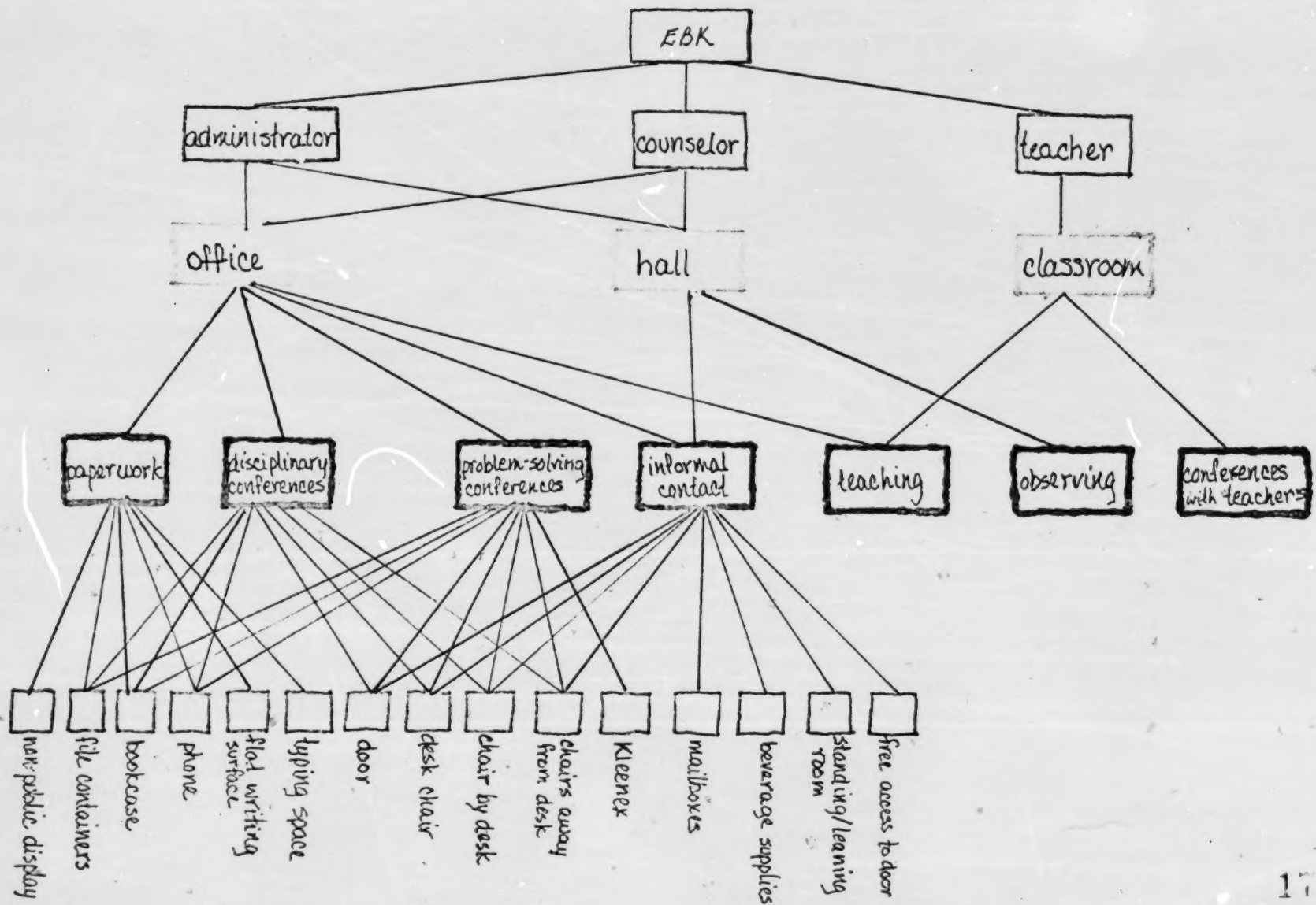


Figure 5. The BPA diagram for an alternative school administrator, showing some environmental elements.